LEARNING AND CONDUCTING PRELIMINARY FIRE INVESTIGATIONS

Executive Leadership

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ABSTRACT

A problem existed in the Battle Creek Fire Department (BCFD) because when the research project was begun, there were no directives (standard operating procedures) for learning or conducting preliminary fire investigations. The purpose of this research project was to identify a set of fire investigation components that could be taught to firefighters and fire officers. This set of components would be the minimum necessary components for learning and conducting preliminary fire investigations. The purpose was pursued through the following research questions:

1. Who should conduct fire investigations?
2. What is the minimum knowledge necessary to conduct preliminary fire investigations successfully at most structure fires?
3. What are the different types of fire investigations?
4. What are the steps for conducting a preliminary fire investigation?
5. What determinations should be made during fire investigations?
6. How should fire investigations be documented?

The research procedures used historical research as an analysis of a literature review to gain data for answering all six research questions. The historical research was both qualitative and thematic in nature. The outline produced as an outcome of this research project was derived from the available data using deductive reasoning.

Descriptive research using a survey produced additional data for analysis of questions one and six. The 23 largest cities in Michigan were contacted to participate in the survey, with 14 departments providing the requested information. The purpose of the survey was to gather information on peer practices. The results of the survey were not

intended to be generalized to any other groups, because the survey was not intended to be random or representative.

The results of the research project found there is a need to conduct preliminary fire investigations prior to calling trained fire investigators. The purpose of the research project was achieved by producing a single outline that will be used to teach preliminary fire investigation skills and also used by preliminary fire investigators as an outline for conducting preliminary fire investigations. A checklist was derived from the outline to assist in conducting preliminary fire investigations.

The results also found that the details of making cause and origin determinations have been largely unavailable to fireground personnel conducting preliminary fire investigations. Specifically, there are four different types of fire investigations and each type must make the same four determinations, which are the four basic objectives of fire investigations. However, each type of investigation also has additional determinations to make and each type calls for a different method of documenting the investigation.

This research project identified four recommendations. The first two involved the Chief of the BCFD using the outline and checklist. The third recommendation was for disseminating the outline and checklist to other organizations with a vested interest for improving the skills of fireground personnel at conducting preliminary fire investigations. The final recommendation calls review and revision of the outline for teaching and conducting preliminary fire investigations.

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INTRODUCTION

Simply put, a problem exists because there are no performance requirements for conducting preliminary fire investigations. Performance requirements are often referred to as the knowledge, skill, and abilities (KSA's) to perform specified tasks. In the Battle Creek Fire Department (BCFD) the standard operating procedures, which are a compilation of KSA's, are referred to as directives. Currently there are no directives regarding the necessary KSA's of learning or conducting preliminary fire investigations.

The purpose of this research paper is to identify a set of the fire investigation components (KSA's) that should be taught to firefighters and fire officers, as well as identify the minimum necessary components of conducting a preliminary fire investigation. The purpose will be achieved by producing a single outline that is used to teach preliminary fire investigation KSA's and also used by fire officers as an outline for conducting fire investigations. The purpose will be pursued through the following research questions:

1. Who should conduct fire investigations?
2. What is the minimum knowledge necessary to conduct preliminary fire investigations successfully at most structure fires?
3. What are the different types of fire investigations?
4. What are the steps for conducting a preliminary fire investigation?
5. What determinations should be made during fire investigations?
6. How should fire investigations be documented?

All six questions will be examined using historical research from an analysis of a literature review. Descriptive research using a survey will produce additional data for analysis of questions one and six. The outline produced will be derived from the available

data using deductive reasoning.

BACKGROUND AND SIGNIFICANCE

The BCFD has a staffing allocation of 3 battalion chiefs, 21 company officers, and 69 firefighters in the fire fighting division, for a total of 93 personnel. The annual report of the BCFD issued in January 1999 included summaries from recent years (Battle Creek, 1999) . During the 1995-1998 time period, the BCFD responded to an average of 151 structure fires annually and 376 total fires annually. The trained fire investigators in the BCFD combined to conduct an average of 74 fire investigations. Interfacing the structure fire logs and the investigative logs, shows during this time period 49% of the structure fires were investigated by trained fire investigators and 51% had the cause determined by the fire officer commanding the fire (or their delegate). The 51% that were investigated by fire commanders were considered to have obvious causes that were not related to arson and also had no serious injuries, fatalities, or major financial losses (Battle Creek, 1999).

A post facto analysis of the referenced BCFD report, shows there were 172 fires (43 annual average) that were ruled as suspicious, incendiary or undetermined structure fires or had a fatality (or serious injury) or were non-structural arson fires with a suspect developed during fireground operations. The BCFD personnel capable of serving as incident commanders have not been taught a systematic approach for effectively determining the origin and cause of fires, and thus have relied on obvious causes. This has resulted in BCFD investigators averaging 74 investigations annually, rather than 43. Producing a concise outline for fire officers who conduct preliminary fire investigations will contribute to fire investigators not being called when they’re not actually needed.

The state police in Michigan conduct a basic fire investigation school twice a year.

The primary purpose of the school in to teach new investigators who have joined the fire marshal division of the state police. Each class has thirty slots and only a few are used by the state police, who open the remaining slots to fire and law enforcement departments. This two week school is highly rated and nationally recognized. Slots are allocated based on the perception of state police administrators of where the investment of the training will do the most good.

During the 1995-1998 time period there were three fire inspectors and one fire marshal assigned the fire prevention bureau at the BCFD. All four of these persons were trained to conduct fire investigations at the state police training school. During this same four year time period, there was an average of 74 fires investigated each year by the fire prevention bureau. The average number of arson structure fires was 34. An average of 20 arson fires per year had suspects identified. The average number of arson fires which had warrants issued was 8.

In May of 1999 the mayor of Battle Creek accepted the state award for arson prevention, presented by the Michigan Arson Prevention Committee. Most Battle Creek city leaders recognize the initiative that the BCFD has coordinated in the fight against arson. The number of arson arrests in the past four years has been an all time high, while the number of fires and number of arson fires has continued to decrease.

Yet, during the past four years, there were less fires investigated by trained inspectors than during 1990-1993. This is despite the fact the bureau staffing increased from two trained inspectors in 1990-1993. Traditionally, the BCFD has had fire inspectors investigate all fires that are not small in dollar loss. But starting in 1995, yearly classes had been taught to the fire fighting division about the necessity of having fire ground personnel

conduct preliminary fire investigations prior to calling for investigators. The basis of these classes came from the NFPA standard for fire officers, which requires fire officers to "Determine the point of origin and preliminary cause of a fire" (NFPA, 1998a). The purpose behind the shift was to reduce overtime while simultaneously increasing the time inspectors could spend on arson fires and other duties, such as fire prevention inspections.

The general attitude of BCFD firefighters and fire officers initially was 'that's not my job.' However, during the past four years, most BCFD employees have accepted as a fact, that conducting a preliminary fire investigation to determine the cause and origin is indeed a duty and responsibility of fireground personnel. However, with this acceptance, has come the desire for knowledge that is the foundation of skill development in determining fire origins and fire causes. Herein lies the problem. A concise manual of the prerequisite knowledge does not exist. The available literature on developing fire investigative skills is directed toward full time investigators and not fireground personnel conducting preliminary fire investigations.

The issue of not having a such a concise manual is confounded because another consequence is BCFD management does not have the means of judging the effectiveness of the efforts of fireground personnel in conducting preliminary fire investigations. Without such a manual, management is not able to hold fireground personnel accountable for performing the specific components of an effective preliminary investigation. Another aspect of this problem, is the inability of management to respond to criticism that a preliminary investigation was mis-handled.

A concise manual of the prerequisite knowledge and the specific steps for conducting a preliminary fire investigation is both wanted and needed by the BCFD

employees and management staff. The impact of creating such a manual will be enhanced performance, establishment of performance standards, and increased confidence of employees. There should also be less overtime for fire inspectors and more time available to focus on the fire investigations that contribute to the well being of the community. Additionally, fire apparatus can clear the fire scene more rapidly when their crews conduct a preliminary investigation of accidental fires, rather than waiting for fire investigators to respond.

This applied research project interfaces well with the Executive Leadership course at the National Fire Academy (NFA). Fire investigations have been managed with a transactional style in the BCFD historically. The process of conducting investigations needs overhaul. This can be accomplished through using a transformational leadership approach. Although all parties are satisfied with the traditional approach toward fire investigations, there is a better way of doing business. This better way is based on redeploying resources to better accomplish mission. Improving this process requires a leader to take risks and use initiative, which are necessary leadership qualities taught in the NFA Executive Leadership course (NFA, 1999a).

LITERATURE REVIEW

The National Fire Protection Association (NFPA) has published pamphlet number 921, as a guide for conducting fire investigations. The first edition of this pamphlet was in 1992 and in the seven following years it has become the most widely referenced source of material regarding fire investigations. Although this 167 page document is widely referenced and very comprehensive, there are a few significant flaws. The document defines a fire investigation as “The process of determining the origin, cause and

development of a fire or explosion" (NFPA 1998b, p. 6). However, this guide does not define fire investigator, except by obvious inference and does not discriminate between different types of fire investigations. This guide also omits any recommendations for acquiring the knowledge, skills and abilities (KSA's) to investigate fires. Again, the inference is that reading this 167 page guide will somehow convey the necessary KSA's even though the basic methodology is described as "a complex endeavor involving both art and science" (NFPA 1998, p. 9).

The NFPA guide 921 added significantly to the professionalism of the field of fire investigation. Most importantly, it identifies a common vocabulary with specific definitions and summarizes the necessary fire science concepts involved with understanding fire causation. The outline produced by this research project must be consistent with the methodology and vocabulary of 921, but more brief and limited in scope.

When the fire investigation conducted by an investigator leads to civil or criminal litigation, the investigator must be able to testify to the court as an expert. The NFPA 921 guide attempts to standardize the requisite steps in an investigation and the documentation of the investigation, although many articles criticize this attempt at standardization.

The NFPA guide 921 is both the title and topic of a four day seminar that is annually co-sponsored by the National Association of Fire Investigators (NAFI) and the NFPA. During the 1995 seminar, many participants described the 167 pages of the NFPA pamphlet 921 as cumbersome and very academic (detail oriented). The student manual from this seminar has an excellent outline of the steps to determine the origin of a fire (NAFI, 1995). Although the outline is written in bullet fashion, rather than narrative, the

outline is still ten pages in length. The detail is based on trying to apply the outline (systematic approach of origin determination) to as many fires as possible. Like the 921 pamphlet, trying to cover all possible scenarios produces disadvantages.

NFPA pamphlet 1021 is the standard for fire officer performance. The standard requires fire officers to possess the KSA's to "determine the point of origin and preliminary cause of a fire" (NFPA 1998a, p. 8). Yet the standard does not reference how the KSA's are acquired or indicators to judge how they are performed. The outline produced by this research project should summarize the knowledge and identify the steps to accomplish the referenced requirement of NFPA 1021.

NFPA pamphlet 1033 is the standard for professional qualifications for fire investigator. The standard defines an investigation as "a systematic inquiry or examination" (NFPA, 1998c, p. 5). The standard does not differentiate between different types or levels of fire investigation. The standard implies that the fire officers who determined the origin and cause at 51% of the Battle Creek structural fires needed to follow the standard because they where functionally investigating the cause and origin of fires.

The importance of the requisite knowledge and skill of a fire investigator are also delineated in the *Fire Litigation Handbook*, (NFPA, 1984). The handbook is written for an audience of attorneys and points out "the fire investigation expert is the critical person in any investigation concerning fire causation" (NFPA, 1984, p. 3). The quote holds true for the audience of lawyers because civil and court cases require expert testimony in order for the court to make determinations of fire causation. Thus through induction, if a court does not need to make determinations of fire cause, then an expert is not required to make cause determinations. Thus, the outline produced by this research project is intended for

fireground personnel (incident commanders, fire officers, and fire fighters) and not full time fire investigators.

There are exceptions regarding the previous assertion that an expert is not required to make all cause determinations. In Lawrence, MA an arson task force was formed in May 1992 after 137 arson fires occurred in the previous five months in the city with a population of 60,000. The task force was multi jurisdictional and FEMA funded publishing a report on lessons learned (Massachusetts State Fire Marshal, 1995). One of the methods found to be effective, was having a fire investigator respond initially to any confirmed fire. Although, that method was found successful, the report did not suggest for the concept to be applied in situations with less critical problems.

The Michigan State Police (MSP) conduct a basic fire investigation school that allows new investigators to be nationally certified as fire investigators through the NFPA. The school does not address the need of or components of a preliminary investigation. The section of the student manual on determining the point of origin is an excellent concise outline (MSP, 1994). Like NFPA 921, this course and the manual are directed toward conducting and documenting a comprehensive fire investigation that is capable of concluding in successful litigation. The outline produced by this research project must be consistent with the MSP manual for basic fire investigation.

There are three texts that are similar to the student manual for the MSP basic fire investigation school in terms of comprehensive approach and national recognition. *Kirk's Fire Investigation* (DeHaan, 1991), *Investigation & Prosecution of Arson* (California District Attorneys Association, 1995), and *Fires and Explosions* (Kennedy, 1085) each are stand alone texts that convey all of the information needed by new full time fire

investigators. Although there are significant differences in the approach taken in presenting the material and in the emphasis each text provides tangential issues, there are no known conceptual discrepancies. The California District Attorneys Association (CDAA) text identifies the following three “musts” for investigators (CDAA, 1995, p. 49):

1. Be able to recognize and interpret the different fire indicators.
2. Understand that in most cases the physical evidence is going to be located at the bottom layer of the debris.
3. Be willing to take time to conduct a thorough scene examination.

The Kennedy text is the only major fire investigation text that recognizes the duty of fire officers for conducting a preliminary fire investigation. The outline produced by this research project must not be inconsistent with the Kennedy text and must summarize the steps in making cause and origin determinations. Although the text does not specify the components of a preliminary investigation, the text does state:

> The fire officer in charge usually supervises the first investigation which is very important. If his finding as to cause is undetermined, suspicious or incendiary, he usually withdraws from the investigation and the fire and arson investigating division of the city, county, or state will move in and assume responsibility. (Kennedy, 1085, p. 6).

The DeHaan text is a major text in the field of fire investigation. The outline produced by this research project must not be inconsistent with the text and must simplify and summarize DeHaan’s approach to making origin and cause determinations.“It is often helpful for the investigator to be present during the fire and it’s suppression” (DeHaan, 1991, p. 93). Nearly every fire investigator would agree with this quote. Being present

during fire extinguishment would be helpful in the investigation and “give investigators the hands-on experience they need to sharpen their skills” (Jackson, 1995, p. 81). Yet most investigators conduct investigations without the benefit of being present during fire extinguishment. When investigators are present during extinguishment, there are consequences or costs associated with the help that is derived, such as;

1. Takes time away from other duties.
2. Precludes officers from conducting preliminary investigations.
3. Requires investigators to go to more investigations.

The “Kirk Approach” explained in the DeHaan text is effectively summarized by William F. Jenaway (1988) as a systematic approach advancing seven key points. The outline produced by this research project must be consistent with these seven key points and must present them in a simplified outline format.

1. At the initial stage of investigation, disregard upper portions.
2. Systematically seek low burns, assuring the very lowest is identified and all burns at similar levels are found.
3. For each low burn found, analyze the fire spread away from it.
4. Next, study the overall pattern to determine the manner in which the fire burned after it developed into a large fire.
5. Next, the outside factors such as wind direction, fire tactics, and chimney action are fit into the pattern to determine their influence.
6. Next, evaluate the low burns in relation to the total fire pattern. Typically, only one is going to be found to be consistent with being an origin. If two or more exist, it is reasonable to assume that a set fire has occurred.

7. If only one low burn is consistent with being the point of origin, then proceed to determine the cause.

The Jenaway text stresses the importance of company officers meeting the NFPA 1021 standard regarding cause and origin determination and also “the responsibility of the company officer and crew to perform the vital initial fire investigation,” (Jenaway, 1988, p. 43). However, the Jenaway text stops short of offering the specific information that the major fire investigation texts offer regarding a systematic approach to cause and origin determinations.

The specified educational objectives of chapter 16 of the *Fire Department Company Officer Manual* (IFSTA, 1999) are the fire investigative competencies outlined in NFPA 1021. However the two pages devoted to origin determination omit most of the information contained in the major investigative texts regarding a systematic approach to making the determination. The outline produced by this research project must not be inconsistent with this manual, but must be more detailed in the systematic approach to determining origins and causes.

Fire Cause Determination (IFSTA, 1982) although outdated, is the best summary reference for the different fire department roles in fire cause determination. The outline produced by this research project must not be inconsistent with the roles explained in this text.

> The company officer’s attitude toward cause determination sets the attitude of the firefighters in the company ... The officer with a positive attitude however, sees beyond the discomfort and inconvenience that might be caused by a thorough investigation ... The officer and the firefighters work together to determine the cause

> of the fire. If their investigation cannot discover the cause or can find no accidental cause, they then call in the trained investigator ... The officer who knows when to call for an investigator is a professional ... Only rarely will the investigator also be unable to find the cause ... Whether the local fire department or some other agency has the legal responsibility for extended fire cause investigations, the chief of the fire department has the primary responsibility, either legal or moral, for seeing that every fire's cause is found ... Since investigators from the other agencies cannot always get to the scene quickly, the local fire department must be prepared to conduct a thorough preliminary investigation (IFSTA, 1982, pp. 12-14).

The National Fire Academy (NFA) developed the second edition of a text book for teaching preliminary fire investigation to company officers in 1983 and used the text in a delivery program for a fire officer skill development class. The class was offered in a 12 classroom hour format delivered through state fire training organizations. The chapter on determining the point of origin is a three and a half page outline that is deficient of the detail in the major texts (NFA, 1983). The text has six chapters and the chapters on legal issues and fatal fires are clearly of more importance to fire investigators rather than fire officers.

The text cited in the previous paragraph was replaced with *Arson Detection for the First Responder* (NFA, 1996b). According to the forward in the text, it is "designed specifically to provide a clear definition of the role of initial responder organizations" (NFA, 1996b, p. iii). The text focuses on the company officer's responsibility for conducting a preliminary investigation, but omits presenting a systematic approach to conduct the preliminary investigation. The manual omits a chapter on origin determination. The outline

produced by this research project must be consistent with the duties and observations that are described for company officers in this text. *The National Fire and Arson Report* (Ford, 1988) identifies the ten most common failures in fire scene investigations. The outline produced by this research project must address these potential failures.

Many of the interpretations made in the past, regarding the cause of crazing on glass, have been determined to be false, (NFPA, 1998b). However, “heavy staining with no crazing indicates a slow fire with considerable smoke” (Sainsbury, 1990, p. 25).

“As a general rule, state statue empowers and directs the fire marshal to investigate the cause, origin, and extent of loss of all fires occurring in the jurisdiction” Wolfe, 1991, p. 1). “In general, and with the exception of large or unique fires, once the fire marshal determines the cause is accidental, his investigation stops,” (Wolfe, 1991, p. 3). Although this is practiced routinely in the fire service, there are few references in the literature supporting the practice. With only a few exceptions, it is considered the best use of limited municipal resources for public fire investigators to avoid being in the middle of civil litigation battles involving an insurance company subrogating their loss to potential responsible parties.

When an investigation of a fire leads to civil or criminal proceedings, then “A well-written and carefully documented report reflects a thorough investigation. In a sense, the report is the investigation” (Bates, 1986, p. 56). Such reports are issued by trained fire investigators to document the justification for the determinations of cause and origin contained in the report.

The fire investigator is trained to function as an expert witness in both civil and criminal litigation regarding fire loss. The communication ability of the fire investigator

determines the effectiveness of the investigator in both report writing and court testifying. “The expert is there to assist the trier of fact to understand the evidence or to determine a fact in issue” and therefore must “logically explain his conclusions” (Kennedy, 1987, p. 42).

“First-arriving firefighters with the right mind set can provide a wealth of information to assist in fire and legal proceedings” (Toll, 1990a). There are many observations that can only be made by the on-scene first responders. Not only must the first responders be interviewed, they must understand their duty to make critical observations during response, on arrival, and during on-scene operations. The outline produced by this research project must include reminders of the critical observations required from the first responders.

“There is a strong need to provide investigators everywhere with more training” (United States Fire Administration, 1990, p. 43). The outline produced by this research project should address that need for a standardized approach to conducting preliminary fire investigations by fireground personnel.

Often times the training given in fire investigation focuses on techniques of examining the fire scene and interviewing involved parties. However, for those techniques to be effectively used, the local fire investigation must be led by someone “with a positive attitude ... to conduct a fire investigation in a professional manner” (Toll, 1990b). After attitude, Toll goes on to explain that the next most important aspects of a successful investigation are the qualities of being accurate, believable, and credible. The outline produced by this research project should further Tolls viewpoint by establishing expectations, standards, and necessary training.

The basic approach of cause and origin determinations, is collecting indicators (observations of fire patterns) and interpreting those indicators to understand the fire

development. Often times indicators are construed “as representing a fact” (Lowe, 1987, p. 51). However, “no one indicator can be taken as the sole, conclusive proof of any fact in a fire situation” (Kamman, 1985, p. 14). Each indicator produced by the fire, must be considered in “the context in which the indicator is observed” (Lowe, 1987, p. 51). The outline produced by this research project should address these concepts.

Rural arson control is the topic of a federal pamphlet of the same name. The pamphlet has twenty-two need statements designed to respond to the difficult challenge of rural arson. The outline produced by this research project should meet the following four need statements, (United States Fire Administration, 1989).

- Need to raise the level of awareness among firefighters about their role in arson prevention, detection, and investigation.
- Initial cause determination should be an integral part of fire suppression.
- Options for firefighters that will optimize their effective contribution to arson control.
- Arson investigator training programs need to stress skills development in areas other than fire cause determination.

A national forum on arson in the United States was convened at the National Fire Academy in 1993. The United States Fire Administration (USFA) published the *Arson Forum Report*, which addressed recommendations in the areas of prevention, training, management, statistics, and investigation (USFA, 1993). The differentiation between fire and arson investigators is defined in this report. The outline produced by this research project should address the following recommendations contained in the *Arson Forum Report*.

- Establish a fire chief's guide to arson.
- Develop guidelines for when it is appropriate for suppression personnel to report on the fire cause.

Investigating The Fireground (Phillips & McFadden, 1996) is clearly the most comprehensive text written on the subject of preliminary investigations. Although the text is too long to serve as an easy reference, the focus is on developing the investigative skills of the firefighters and fire officers responsible for extinguishing the fire. The text fails to describe the different types of investigations and also uses the term fireground investigation rather than preliminary fire investigation. The text defines the primary objectives of a fire ground investigation as making determinations of origin, heat source, reason for the fire and category of the fire. The outline produced by this research paper will use these objectives as the structure of a systematic approach for conducting preliminary fire investigations.

PROCEDURES

As stated in the introduction of this research paper, a problem exists because there are no performance requirements for conducting fire investigations in the BCFD. The purpose of this research paper is to identify a set of fire investigation components (KSA's) that should be taught to firefighters (and fire officers) and identify the minimum necessary components of conducting a preliminary fire investigation. The purpose will be achieved by producing a single outline that is used to teach preliminary fire investigation and also used by fireground personnel as an outline for conducting preliminary fire investigations. The purpose will be pursued through answering six research questions using historical data gathered through an analysis of a literature review. Descriptive research using a survey will

produce additional data for analysis of questions one and six. The scope of the outline produced with these procedures applies to firefighters and fire officers conducting preliminary fire investigations of structure fires. The outline produced will be derived from the available data using deductive reasoning. The answers to each of the six research questions should be included in the content of the outline produced as a product of this research project.

The historical research is both qualitative and thematic and will begin with reading a major investigative text, (Phillips & McFadden, 1996) and highlighting information that should be included on a summarized outline. Next, each highlighted sentence in the text will be typed into a series of stand alone sentences in a computer database. Finally each sentence will be simplified (reworded) and re-ordered sequentially, to coincide with conducting a preliminary fire investigation of a structure fire. Once this process is concluded, each additional reference from the literature review will be evaluated for inconsistencies or missing steps or concepts.

The final outline will be thematically re-organized and typed in a format to be used as an outline for a lesson plan teaching preliminary fire investigation skills. This outline will then be reduced to a checklist of reminders for fireground personnel to use when gathering data.

There are two fundamental limitations with the historical research. First is the judgment of the researcher regarding what texts to include in the literature review. Missing major texts or over emphasizing the importance of minor references will distort the results and the usefulness of the product produced by the research. The second significant limitation is the analytical intellect and deductive reasoning of the researcher that must

synthesize a mountain of data into a concise summary outline. The usefulness of the product of the research, would appear correlated to the researcher's skills in these areas. These limitations combine to increase the likelihood that a replication of this research project would be difficult.

Research questions one and six need current information regarding peer practices. This information will be gathered through descriptive research using a survey. The questionnaire has been devised to gather qualitative and quantitative data using both open and closed questions. A copy of the questionnaire is displayed in appendix A. The purpose of the survey is to gain current data not available in the literature. The sample includes the twenty-three largest fire departments in Michigan. A copy of the list of departments to be contacted is displayed in appendix B. The departments will be contacted by a fire science intern of the BCFD for a phone interview during the last week in June, 1999. Due to three qualities of the sample, i.e., sample size, lack of randomness, and lack of established representativeness, the characteristics of the sample cannot be generalized to a larger population. However, this limitation does not negate the benefit of gaining insights of peer practices.

The outline produced as a product of this research requires a number of terms to be defined, in order for the outline to be used with uniformity by multiple individuals in differing circumstances. However, there are no terms that must be defined in order for the research project to be conducted.

RESULTS

The survey results are included as appendix C. Fourteen of the twenty-three departments identified in the sample provided responses. The responses to each of the

survey questions were basically answered the same by all respondents or were grouped about half and half. For instance, all respondents utilized full time investigators working 40 hour work weeks. Not counting Detroit, each respondent had 2-4 full time investigators and conducted from 26-250 investigations a year as a department. Only 4 departments had 10 or more arrests. Ten departments provided training in conducting preliminary fire investigations. Eight departments require a preliminary investigation prior to calling a fire investigator. Seven departments have written criteria explaining when to call an investigator. No department had performance criteria for conducting a preliminary fire investigation.

Question 1. Who should conduct fire investigations? The historical research found a strong justification for the approach that requires a delegate of the fire chief to conduct a preliminary fire investigation with the objectives of determining origin, heat source, fire cause, and fire type. If these determinations cannot be made, or the preliminary cause is arson, or if there is a fatality, serious injury or high dollar loss, then a fire investigator should conduct an investigation and provide documentation of the rationale for the determinations. The survey found roughly half the departments utilizing preliminary fire investigations conducted by fireground personnel. Each department should have access to a trained fire investigator.

Question 2. What is the minimum knowledge necessary to conduct preliminary fire investigations successfully at most structure fires? The answer to this question is the composite outline produced as a product of this research project. The outline is displayed in appendix D. The minimum knowledge referred to in this research question, is best viewed in terms of six categories of minimum knowledge. The categories and content of

each category are derived from the historical research conducted through the literature review. All six categories are subsections of the outline produced as a product of this research project. The first category is called basic firefighting principles and includes necessary concepts from fire science and building construction. The second category is the basic structure of fire investigations including definitions, types, objectives, and components. The third category is an outline of the method for determining fire origins. The fourth category involves the methods for examining fire origins. The fifth category is the methods for determining fire cause. The sixth and last category is the guide for determining fire type.

Question 3. What are the different types of fire investigations? Four different types of fire investigations are explained in the outline (preliminary fire investigations, private fire investigations, public fire investigations, and arson investigations). Few texts reference all types of investigations. Each type of investigation is compared and contrasted by viewing who conducts the investigation, objectives of the investigation, documentation of the investigation, and when the investigation occurs.

Question 4. What are the steps for conducting a preliminary fire investigation? The steps for conducting an investigation and the minimum knowledge for conducting an investigation have been combined in the outline to achieve brevity and simplicity. This data primarily comes from the major texts written for full time investigators.

Question 5. What determinations should be made during fire investigations? Four basic determinations are made which correlate to the four objectives of fire investigations (fire origin, heat source, fire cause, and fire type). Guidelines for making these determinations are contained in the outline in appendix D. During preliminary fire

investigations, there are numerous minor determinations that must be made to rule out the possibility of arson. These minor determinations are derived from the outline in appendix D and are listed on a checklist in appendix E.

Question 6. How should fire investigations be documented? The outline describes the minimum documentation for each type of investigation. Preliminary investigations need only the basic statistical incident report to be completed. Some texts required all investigations to be thoroughly documented, but those texts did not recognize preliminary fire investigations as a type of investigation. No department responding to the survey required personnel to complete any forms when conducting preliminary investigations, except the statistical incident report. However, a form to collect basic information for later reference would be useful for preliminary fire investigators. The checklist in appendix E can serve this purpose.

DISCUSSION

The results of this research project clearly show a need to conduct preliminary fire investigations and for creating an outline to learn how to conduct preliminary fire investigations. The detailed information on cause and origin determinations that is generally distributed only to trained fire investigators, must also be made available to fireground personnel. Conducting preliminary fire investigations, is a duty delegated to the officer in charge of each fire (NFPA 1998a). Yet only one text recognized the function of conducting a preliminary fire investigation and also provided the detailed steps and knowledge necessary to make origin determinations (Phillips & McFadden, 1996).

Five major texts were reviewed on the subject of conducting fire investigations; NFPA 1998c, CDAA, 1995, MSP, 1994, DeHaan, 1991, Kennedy, 1985. The audience for

each of the major texts was trained full time fire investigators. All five texts conveyed an adequate amount of knowledge for a new investigator to conduct a fire investigation. Each text provided extreme detail regarding the steps and methods for determining fire origins, which is the key to conducting fire investigations. The content of each text is also presented in classroom situations (seminars) geared for trained fire investigators.

Both in the literature and in practice, there are few examples of trained fire investigators sharing their knowledge with the fireground personnel conducting preliminary fire investigations. Comments from departments and investigators have justified the not sharing of knowledge based on fears of losing job security, fears of fire officers messing up investigations, fears of losing overtime compensation, and fears of decreasing competence because investigators would investigate fewer fires.

Most Michigan fire departments do not have full time staff, and thus do not have trained fire investigators (Michigan State Police, 1998). A consequence, is most departments recognize a need to conduct a preliminary investigation prior to requesting a state employed fire investigator to respond. The primary method of these departments for acquiring the skill to conduct preliminary fire investigations comes from the *Fire Department Company Officer Manual* (IFSTA, 1999) and the fire officer class *Arson Detection For The First Responder* (NFA, 1996b). Both of these references lack sufficient detail for readers to acquire the knowledge, skills and abilities to determine the origins at most fires. This helps explain the very high percentage rate (29.9) of residential structure fires with undetermined cause in Michigan (Michigan State Police, 1997).

The outline produced by this paper will benefit any fire department that chooses to provide training to fireground personnel in conducting preliminary fire investigations.

Because of the expressed limitations regarding the creation of the outline, it is both possible and probable that the outline will be refined if it is used in other fire departments. Likewise, it should be refined each year that it is used in the BCFD.

The specialized field of fire investigation has gone through numerous changes during the 1990's. The greatest of these changes is arguably the publication of NFPA pamphlet 921 (NFPA, 1998c). However, the decreasing frequency of fires, the changes in building construction codes, the general fire safety knowledge of the public, the new federal OSHA regulations, the increasing number of insurance company subrogations, the proliferation of civil litigations, and the new court cases that have clarified arson law mean that fire investigations will continue to change drastically in the next decade.

To the influences on fire investigations specified in the previous paragraph, add the influence of the public wanting more for less and the dwindling tax revenues in cities where most departments have trained fire investigators. These influences combine to justify the value of conducting preliminary fire investigations according to the outline produced by this research project. Such a practice will likely produce organizational implications that will result in the following benefits to the BCFD;

- Less overtime paid to investigators.
- Fewer fires investigated by investigators.
- The ability to function with two investigators.
- Fewer disruptions for investigators during their off duty time.
- Increased on-duty time to deploy into fire inspections.
- A closer working relationship between fire officers and fire investigators.
- Fire apparatus being placed in service more quickly after accidental fires.

- Increased confidence of fire officers to determine fire origins and causes.

RECOMMENDATIONS

Recommendation #1: It is recommended that the Chief of the BCFD modify the directive (standard operating procedure) for fire investigations to require conducting preliminary fire investigations consistent with the outline contained in appendix D. This recommendation will support the fire officer skill development for determining fire cause and origin described in the NFPA pamphlet 1021 (NFPA, 1998a).

Recommendation #2: It is recommended that the Chief of the BCFD create a directive that requires the incident commander at all fires (or their delegate) to complete the checklist in appendix E. This will allow BCFD administrators to be assured that indicators of arson are not overlooked and also provide for collecting information for later reference if inquiries are made (Phillips & McFadden, 1996).

Recommendation #3: It is recommended that the Chief of the BCFD provide copies of the outline contained in appendix D to the Michigan chapter of the International Association of Fire Investigators, the Michigan chapter of the International Association of Fire Chiefs, and the Michigan Fire Fighters Training Council. The purpose of disseminating the outline would be to seek to improve the outline and afford other departments the opportunity to provide detailed and standardized information regarding conducting preliminary fire investigations. This recommendation is supported by the needs assessment in *Arson Forum Report* (USFA, 1993) and *Rural Arson Control* (USFA 1989).

Recommendation #4: Future readers of this research project are encouraged to require the fire officers in their departments to conduct preliminary fire investigations

consistent with the outline contained in appendix D. Each time a reader takes this outline and applies it to their department, they are challenged to improve the outline.

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APPENDIX A

FIRE INVESTIGATION QUESTIONNAIRE

1. Are there full time fire investigators on your department?Y - N

2. Do they work 40 hour work weeks?Y - N

3. How many full time investigators? _____

4. How many fires investigated last year by fire investigators?_____

5. Was the last question ACTUAL - ESTIMATED?(Circle one)

6. What is the average number of fires per year that have arrests made? ____

7. Was the last question ACTUAL - ESTIMATED? (Circle one)

8. Is a report required on accidental fires that don't involve injuries/fatalities? Y - N

9. Is there written performance criteria for trained fire investigators? Y - N
   If yes, please fax a copy.

10. Are fire ground personnel required to conduct a preliminary fire investigation prior to calling a fire investigator? Y - N

11. Are fire fighters & fire officers provided training, on duty, to learn how to conduct preliminary fire investigations? Y - N If yes explain or provide material.
    _____
    _____

12. Is there written criteria for fire ground personnel explaining when to call a fire investigator? Y - N If yes explain or provide material.
    _____
    _____

13. Is there performance criteria (such as an outline, checklist, duties, etc.) for fire ground personnel conducting a preliminary fire investigation? Y - N
    If yes explain or provide material.
    _____
    _____

APPENDIX B

LIST OF DEPARTMENTS IN THE SURVEY

Rank*	City	Fires**	Population	Employees	Fire Marshal	Phone
1	Detroit	8,314	1,012,000	1,235	R. Michalik	313-596-2926
2	Flint	706	139,000	212	T. Wiggins	810-762-7364
3	Grand Rapids	486	191,000	268	R. Roersma	616-456-3900
4	Saginaw	305	70,700	97	T. Snowden	517-759-1376
5	Lansing	272	126,000	241	J. Ballard	517-483-4200
6	Pontiac	245	69,000	117	R. Minard	248-857-5608
7	Warren	223	142,000	172	D. Burrick	810-756-2800
8	Dearborn	180	88,000	116	R. Polcyn	313-943-2131
9	Battle Creek	174	54,000	103	J. Moody	616-966-3557
10	Kalamazoo	171	81,200	DPS	M. Myers	616-337-8-68
11	Taylor	158	70,200	40FT-75PP	G. Smith	734-374-1355
12	Ann Arbor	138	109,000	113	S. Rayburn	734-994-2772
13	Westland	130	85,000	72	P. Harder	734-467-3261
14	Sterling Hts	123	118,000	102	F. Cowper	810-726-7000
15	Southfield	107	81,000	105	Chief R. Ozias	248-354-7808
16	Wyoming	98	64,000	32FT-60PP	J. Hutchison	616-530-7250
17	Farmington Hls	90	76,000	30FT-90PP	S. Hume	248-426-4400
18	Troy	86	78,000	10FT-170PP	D. Roberts	248-524-3419
19	Royal Oak	81	67,000	70	T. Lapado	248-546-6315
20	Rochester Hills	75	64,000	15FT-85PP	G. Waterhouse	248-656-4720
21	Livonia	74	101,000	92	R. Whitehead	734-466-2444
22	Dearborn Hts	65	59,000	53FT-22PP	B. Mazur	313-277-7731
23	St Clair Shores	62	67,000	51	K. Karapuz	810-445-5380

* Rank is based on the average number of structure fires (Moody, 1997).

* * Fires are the number of structure fires averaged over a five year time frame (Moody, 1997).

APPENDIX C

TABULATION OF SURVEY RESPONSES

1. Are there full time fire investigators on your department? **Yes=14 & No=0**

2. Do they work 40 hour work weeks? **Yes=14 & No=0**

3. How many full time investigators? **2-2-2-2-2-2-3-3-3-3-4-4-4-20**

4. How many fires investigated last year by fire investigators?
26-44-50-74-91-100-125-135-150-200-250-4,000-plus two unknown

5. The last question ACTUAL **(2)** - ESTIMATED **(12)**

6. What is the average number of fires per year that have arrests made?
10% - 25-25-10-8-7-5-2-2-2-1-1-?-?

7. Was the last question ACTUAL **(2)** - ESTIMATED **(12)**

8. Is a report required on accidental fires that don't involve injuries/fatalities?
Yes=6 No=5 Depends=3

9. Is there written performance criteria for trained fire investigators? **Yes=6 No=8**

10. Are fire ground personnel required to conduct a preliminary fire investigation prior to calling a fire investigator? **Yes=8 No-6**

11. Are fire fighters & fire officers provided training, on duty, to learn how to conduct preliminary fire investigations? **Yes=10 No=4**

12. Is there written criteria for fire ground personnel explaining when to call a fire investigator? **Yes=7 No=7**

13. Is there performance criteria (such as an outline, checklist, duties, etc.) for fire ground personnel conducting a preliminary fire investigation? **Yes=0 No=14**

APPENDIX D

PRACTICAL GUIDE FOR CONDUCTING PRELIMINARY FIRE INVESTIGATIONS

I The following basic firefighting principles are building blocks in fire investigation.

A. The definition of fire (combustion) is "the self sustaining process of rapid oxidation emitting heatand light."

2. The four types of fires are ordinary combustibles, liquids, electrical, & metals, also called class A, B, C, & D. Each type of fire has specific extinguishment methods.

3. The fire triangle (heat, fuel & oxygen) explains how fires are ignited (when the three sides come together) and the fire tetrahedron (heat, fuel, oxygen & uninhibited chain reaction) explains how fires are extinguished (when one of the sides are removed).

4. The four by-products of fire are heat, flame, smoke and fire gases.

5. Fire burns up and out, as explained through the principles of buoyancy and convection.

6. The heat emitted from a fire is transferred away from the fire through the methods of conduction, convection, and radiation.

7. The three stages of fire development are incipient, free flaming, and smoldering.

8. Each fire has a cone-shaped plume rising from the area of combustion. Air enters the plume through a process called entrainment, that draws fresh air into the plume. The plume contains the by-products of combustion.

9. The movement of heat, flame & smoke are capable of leaving patterns on vertical surfaces when the plume contacts the vertical surface. The value of this type of pattern is showing the direction of the movement of the heat, smoke or flame. These directional patterns are commonly called "V" patterns.

10. The cone-shaped plume can become distorted in shape when air currents (that are not in the plume) push against the sides of the plume.

11. Ventilation is the primary influence on the path taken by a fire. A fire may ventilate itself (burn through a window), receive natural ventilation (use an open window), use construction features (open shafts) or be ventilated through fire fighting operations.

12. Construction features, contents and fire fighting tactics affect the path a fire takes as it spreads through a structure.

13. Construction features affect fire travel through type of construction, interior space configuration, void spaces, vertical shafts, atriums, and building materials.

14. The danger of collapse primarily involves weakening a single piece of a truss

assembly. This is usually faster with steel than wood because steel conducts heat, elongates, and loses it's integrity at 1000°.

15. Firefighters are required to make observations of conditions and events during response, upon arrival, and during operations, as well as account for actions taken.

    1. Observations during response are fleeing persons/vehicles & forced delays.

    2. Observations on arrival are: Doors & windows - open/closed & locked/unlocked
       Smoke & flames - location, color & velocity

    3. Observations during firefighting are flames & smoke, interior doors, reactions of flames to hose streams and obstructions to firefighting operations.

16. Key Definitions:

    1. Backdraft: A smoke explosion that occurs when oxygen is rapidly introduced into a confined space containing a fire that has entered the smoldering phase.

    2. Balloon construction: An older form of construction where the studs run from the foundation to the eaves, allowing fire to rapidly spread once it enters the walls.

    3. BLEVE: A boiling liquid expanding vapor explosion.

    4. Fire patterns: These are the visible or measurable physical effects that remain after a fire. There are many types of patterns. The most useful include:

        4. Movement patterns: Commonly called "V" patterns. They are created by the upwards & outwards movement of heat, smoke, or flame inside the plume, when the plume contacts a vertical surface.

        5. Heat patterns: These include the melting of various materials (plastics, glass, aluminum, etc.) and the blistering of surface finishes like paint from movement patterns or at heat demarcation lines.

        6. Wood char patterns: The blackened pieces of carbon that are left after exposure to fire. When char is evident, some of the wood mass was consumed by the fire. The resulting shrinkage of the wood produces an alligatoring pattern of grooves and raised areas. These patterns are most useful in identifying where combustion took place and in comparing areas within the same fire for the amount of consumed material.

    5. Flammable vapors and gases: These can only be ignited if there is a heat source above the ignition temperature and the concentration of the vapor or gas is in the flammable range, which means above the lower explosive limit (LEL) and below the upper explosive limit (UEL).

6. Flashover: The moment in time when all the exposed surfaces of all uninvolved combustibles reach ignition temperature at virtually the same time in a room.

7. Flash point: The temperature that a liquid must be to produce a sufficient amount of vapor for a fire to occur.

8. Mushrooming: The horizontal and downward movement of the byproducts of fire, which occurs because the plume was first limited by a ceiling and next was limited by walls. The mushrooming of heat and smoke will generally leave a demarcation line on walls showing how low the heat and smoke was pushed by the mushrooming affect.

9. Subrogation: The method of insurance companies recovering the costs paid to claimants by suing the responsible parties.

II The following are the components and structure of fire investigations:

1. The objectives of a fire investigation are making four determinations.

    1. Point of origin: The location of the first ignited material (fuel).
    2. Heat source: The item that produced the heat of ignition.
    3. Fire cause: The reason (event) that combined the heat & fuel.
    4. Fire category: The two categories are arson and accidental.

2. A fire investigation is a search for information about the fire using the techniques of questioning and examining. The results from both techniques are then compared.

3. Investigation of a building fire is comprised of four major parts, with the time spent on each part varying with each fire. The parts are:

    1. Examination of the surrounding area.
    2. Examination of the building exterior.
    3. Examination of the building interior.
    4. Questioning involved persons.

        a. Who reported and who discovered the fire.
        2. The owner and occupants.
        3. Obvious witnesses or neighbors.
        4. First responders (firefighters and any arriving before them).

4. There are four types of fire investigations.

    1. Preliminary investigations:

        1. Conducted by fireground personnel.
        2. Objectives are determinations of origin, heat source, cause, & fire type.

3. Documentation, generally, is the NFIRS incident (statistical) report.
4. The investigation begins as soon after extinguishment as possible.

2. Public fire investigations:

    1. Conducted by trained investigators, generally working for the local fire dept.
    2. Objectives are determinations of origin, heat source, cause, & fire type.
    3. Public fire investigations are only needed in the following circumstances:
        1. The preliminary investigation cannot determine an origin.
        2. The preliminary investigation finds the fire to be intentionally set.
        3. The preliminary investigation finds suspicious conditions or events.
        4. The fire had a serious injury, fatality, or high dollar loss.
    4. Documentation:
        1. If ruled accidental, generally only an NFIRS report unless there are mitigating reasons, such as a serious injury, fatality or high dollar loss.
        2. For arson fires and accidental fires with a serious injury, fatality, or high dollar loss, a report (including pictures, drawings, etc.) is issued reflecting the rationale for the determinations.
    5. These are generally conducted with fireground personnel still on scene

.

3. Private fire investigations:

    1. Usually conducted on behalf of insurance companies by contractors, they are also conducted on behalf of those accused with having responsibility for the cause fire.
    2. Objectives are:
        1. Determinations of origin, heat source, cause, & fire type.
        2. Determinations of responsibility for the fire or subsequent loss.
    3. Documentation is a report (including pictures, drawings, etc) reflecting the rationale for the determinations.
    4. These are generally conducted within a few days after the fire.

4. Arson investigations:

    1. Conducted by law enforcement personnel.
    2. Objectives are:
        1. Determinations of origin, heat source, cause, & fire type. Sometimes these determinations are delegated to fire investigators, depending upon many factors.
        2. Determinations of who is criminally responsible for arson fires.
    3. Documentation is a report (including pictures, drawings, etc) reflecting the rationale for the determinations.
    4. There is no usual time frame for these investigations.

III The following is a systematic approach for determining the origin of a fire:

1. The basics of this approach will assist in making effective determinations of the origin at most fires. However, this approach is not designed to be all inclusive of the useful techniques in making these determinations.

2. The first objective in a fire investigation must always be determining the origin.

3. The first step is always determine the rights of the investigator to conduct the investigation on the fire scene. Generally, the right to investigate comes as an extension of firefighting operations, by consent of the owner/occupant, or by a warrant. There are exceptions.

4. Unauthorized persons should be prevented from entering the fire structure and the surrounding area from the time firefighters arrive until the investigation is complete.

5. Examine the surrounding area (approximately 20-30 feet from the building) by walking a circular path around the building and paying particular attention for:

    1. Discarded tools, containers, and valuables.
    2. Grounds involved with fire.
    3. Footprints and tire tracks.

6. Examine the building exterior, by walking a circular path around the structure a second time, and paying particular attention to:

    1. Smoke stain patterns.
    2. Flame char patterns.
    3. Points of entry into the building & signs of forcible entry.
    4. Condition & placement of windows and doors.
    5. Position and condition of utility meters.

7. Examine the building interior. Focus on determining the room of origin.

    1. Don't investigate the interior of a building without first making a determination that it is safe to do so and obtaining the necessary safety equipment.

    2. Before starting the interior examination, try to get a feel for what might have occurred. However, do not come to any conclusions initially concerning the origin and spread of fire.

    3. When investigating fires, try not to make decisions based on one indicator or pattern.

    4. After examining the building exterior and surrounding area, enter the building from the doorway associated with the least fire damage.

    5. Do a brief walk-through of the building to get an idea of the layout and which

rooms received fire damage.

6. Trying to observe too much information during the interior examination will cause sensory overload. Look at one area or pattern at a time. Learn to focus attention.

7. Conduct a second walk-through of the building, but slower. The purpose of the second walk-through of the building is to determine the room of origin.

    1. Start the 2nd walk-through of the building on the lowest level that has fire damage. Begin the 2nd walk-through in the least damaged room or area.

    2. Begin moving slowly toward the areas with most fire damage observing the patterns made by the movement of heat smoke and flames (demarcation lines & V patterns). Patterns should become heavier and/or darker and lower as the room of origin becomes closer.

    3. The movement of heat, smoke and flame can leave the same patterns on contents and human bodies, as on walls and ceilings.

    4. The patterns left by the movement of heat, smoke and flame should be understood or “read”. Doing so, allows the investigator to explain how the fire spread through the building.

    5. The shape of the patterns and the decreasing severity of burned material, is specifically what permits the patterns to be read.

    6. In each room or corridor in the second walk-through, find multiple patterns to indicate the direction of movement of fire by-products.

    7. <u>The direction of fire travel must be explained by showing a continuity of the patterns produced by the movement of the by-products of fire.</u>

    8. When fire burns through a horizontal surface, like a floor, the direction the fire was moving must be determined. Examination of the edges of the burned surface will reveal either a V or an inverted V pattern to document the movement.

    9. Have multiple reasons (patterns) supporting the determination for room of origin.

8. The next step is to determine the point of origin within the room of origin.

    1. Generally, the most ceiling damage will occur over the origin.

    2. Generally, the fire burned longest and did the most damage (consumed the most material) at the origin.

3. Generally the area of lowest burning will be the origin, unless the lowest burning is caused by “fall down”.

   NOTE: Multiple areas of low burning can be due to multiply set fires or multiple areas of fall down. Determine which is the correct analysis by comparing the patterns and amount of charring between the areas of low burning. The true origin will usually be associated with the area of most consumed material. Also, look for what could cause fall down and compare to information gained from questioning occupants about contents in the area of low burning.

4. The movement patterns (V patterns) on the walls and contents in the room of origin can help point to the origin.

5. Occasionally, “reconstructing the scene” is necessary to find a specific origin. Firefighters on attack lines and occupants can provide indicators of where furniture was placed during the fire. Once the furniture is placed in the original locations, movement patterns on the furniture can help indicate the origin. When reconstructing the scene, the protected spots on the floor where the furniture legs set will help place furniture.

6. When a point of origin within a room cannot be determined, then attempt to determine as small an area of origin within the room as possible.

7. If the origin of the fire is an area on the floor, then the edges and underside of flooring material and flooring boards should be examined.

8. When the above methods fail to identify the point or area of origin, try sectoring the room in half and determine which half had the most consumed material. If this succeeds, divide the half with the most consumed material again. Continue this process as far as possible.

9. Have multiple reasons (patterns) substantiating the point of origin.

IV The following is a systematic approach for examining the origin:

1. Examine debris at the origin. It must be removed carefully, layer by layer, looking for evidence of the heat source and identification of the first ignited material.

2. When a potential heat source is identified, make sure that it was capable of transmitting enough heat to ignite the first combustibles at the origin. The types of heat are mechanical, electrical, solar, chemical & direct flame. The following are summaries of useful reminders in determining heat sources.

   1. Spontaneous combustion is one type of chemical heat. The primary methods of spontaneous combustion are the natural breaks of long-string hydrocarbons (linseed oil, fish oil, vegetable oil, etc.), decomposing cellulose (wet bales of

hay), and piles of wet coal or charcoal.

2. Damaged appliance cords are the main cause in electrical fires. Permanent wiring is unlikely to be the cause.

3. The second most common electrical fire is due to the heat created by high resistance electrical connections (loose wires and carbon tracking).

4. When many plastics burn, they melt and flow like a flammable liquid, while their vapors burn. If there is a floor pattern at the origin, it is necessary to determine if there was plastics in this area prior to the fire which could cause this pattern.

5. Smoke and burn patterns can be easily traced back to a major appliance that was the source of heat for the fire. It is much more difficult or impossible for investigators to determine exactly what happened within the appliance. Preliminary fire investigators, public fire investigators, and arson investigators are cautioned against identifying specific causes in accidental appliance fires due to the subsequent subrogation battles. In these investigations, the focus is on determining if the fire entered or emanated from the appliance near the origin.

6. Careless smoking can cause a fire in an upholstered chair or sofa, if the ash falls between cushions, thus preventing air from cooling the ash. In these circumstances, the cigarette can smolder for an average of 90 minutes before the first flames appear.

7. Cooking fires are primarily caused when pans of grease are ignited, food is left unattended, or combustibles are left laying too close to burners. Cooking fires account for approximately 25% of all residential structure fires.

8. When no logical heat source can be found, then direct flame (arson) must be considered.

9. Spoiliation is the act of carelessly destroying evidence that a liable party needs to prove civil responsibility. The penalty is those found guilty of spoiliation assume financial responsibility. This is most likely to occur by <u>carelessly</u> destroying the heat source at the origin.

V A following is a systematic approach for determining the cause:

1. By definition, the cause of the fire is the reason or event that brought the heat source and first ignited item together.

2. The determination of the cause of the fire is entirely based on the investigator's opinion, which is formulated based upon the evidence (information) gathered.

3. In making a cause determination, compare the information (evidence) gathered through questioning (firefighters, owner, occupant, & witnesses) with the information

(evidence) gathered through examining (surrounding area, exterior, interior).

4. When determining fire cause, always consider the five most common causes of accidental fires (cooking, heating, electrical, careless smoking, and children playing with fire) and all other reasonable causes. Use the following method to rule out potential fire causes.

    1. Analyze the data (inductive reasoning): Reflect on the following information:

        1. Patterns confirming the origin determination
        2. The debris at the area of origin
        3. Information gained through questioning

    2. Develop an hypothesis: Based on an analysis of the data, identify every reasonable explanation for how the required amount of heat was created at the origin and transferred to the first ignited combustibles. Each explanation is an hypothesis.

    3. Test the hypothesis (deductive reasoning): Rule out each possible explanation by examining the data collected. An hypothesis is considered ruled out when the available information fails to support the conditions necessary for the hypothesis to occur.

    EXAMPLES: The origin of a late night fire is confirmed to be the living room sofa. Children playing with fire can be ruled out as a cause, if there were no children present during the few hours before the fire began. The occupants must be interviewed before children playing with fire can be ruled out.

    NOTE: The time spent determining (ruling) fire cause will vary with each fire. The determination is documented in the appropriate report. The process of making the determination is referenced for fires that are ruled arson fires, with a summary statement that all accidental causes have been ruled out.

E. Indicators of an arson fire include:

    1. Indicators related to combustion:

        1. Multiple points of origin
        2. Trailers
        3. Presence of flammable/combustible liquids at the origin
        4. Intense unnatural fire
        5. Unusual fuel load or configuration
        6. Absence of all accidental causes

    2. Indicators of arson not related to combustion:

        1. Remote locations with a blocked view
        2. Fires near appliances

3. Removal or replacement of contents
4. Absence of personal items
5. Entry blocked or firefighting operations obstructed
6. Sabotage to structure or fire protection system
7. Evidence of other crimes
8. Indicators of forced entry

6. Reminders before finalizing cause determinations.

1. Since fire burns up and out, floors must always be examined in the area of origin.
2. Determine how ventilation occurred and it's affect on the fire
3. Determine if flashover occurred and it's affect of any floor patterns.
4. Examine the underside of shelving, chairs, tables, etc. in the room of origin.
5. Examine the sides of floorboards if there are floor char patterns at the origin.
6. Clocks can give an indication of the time of the fire, but may not be accurate.
7. Determine if there was a delay in transmitting the alarm.
8. The presence & operational ability of any fire protection systems must be made.
9. Both involved and un-involved areas should be checked for abnormal placement of contents. Look for contents that are out of place, in disarray, of the wrong type, too meager, too plentiful, or any unusual items or conditions.

VI Type of fire:

1. Accidental fires: Effectively communicating the cause to involved persons (owner & occupant) will save later complaints and create goodwill. The best way to do this is by explaining the rationale for determining the origin. Remember the old adage, "prove the origin and the cause speaks for itself."

2. Undetermined fires:

1. The minimum level of confidence must be probable at accidental fires.

2. The minimum level of confidence must be conclusive on an arson fire.

3. When the investigator does not have the minimum required level of confidence in their opinions regarding the fire cause, then the fire must be ruled to be undetermined (having an undetermined cause).

3. Arson fires:

1. The investigator is responsible for providing gathered evidence (information) that supports the determinations of origin, heat source, fire cause and fire type.

2. The method of supplying the information supporting the determinations is primarily influenced by the office of the County Prosecuting Attorney and the

protocol of the organization employing the investigator.

3. The primary method of supplying the evidence supporting the determinations of origin, heat source, and cause are:

    1. The investigator submits a written investigation report which summarizes a description of the thing (house, car, etc) that was burned, the fire damage, affects of firefighting, interviews, investigative actions, and the evidence (patterns, observations, etc.) supporting the determinations contained in the report. If there is any evidence beyond the interviews, photographs of patterns, and analysis of patterns, then descriptions of that evidence and it's analysis should also be included.

    2. Depending upon many variables, the investigator has an assortment of tools to use to convey the rationales substantiating the determinations of origin, heat source, and cause. Generally, the most effective methods are a simple floor plan of each involved level of a structure fire and pictures of the damage and fire patterns.

APPENDIX E

PRELIMINARY FIRE INVESTIGATION CHECKLIST

Incident #: _____ Alarm time:_____ Address: _____

Determinations: Examine the surrounding area, building exterior, & building interior. Be able to explain your reasons for the following five questions. Have multiple indicators (patterns and/or reasons for each determination).

1. Room of origin:

   _____
   _____

2. Point of origin:

   _____
   _____

3. Heat source:

   _____
   _____

4. Fire cause:

   _____
   _____

5. Fire category: Accidental Arson Undetermined cause Suspicious

Examining Reminders for preliminary fire investigations:

1. Does the BCFD have rights to do an investigation? Get a consent to search signed.
2. Is the area properly secured?
3. Examine the surrounding area (approximately 20-30 ft) looking for discarded tools, containers, and valuables, grounds involved with fire, or footprints and tire tracks.
4. Examine the building exterior. Walk a circular path around the structure a 2nd time, looking for smoke stain patterns, flame char patterns, points of entry into the building & signs of forcible entry, condition & placement of windows/doors and position/condition of utility meters.
5. Examine the building interior. Focus on determining the room of origin.
   1. Don't make decisions on the basis of one indicator or pattern.
   2. Enter the building from the doorway associated with the least fire damage.
   3. Do a brief walk-through of the building. Get an idea of the layout and fire damage.
   4. Do a 2nd walk-through of the building, but slower, to determine the room of origin.
   5. Start the 2nd walk-through on the lowest level with fire damage, in the least damaged area.
   6. Move slowly toward the areas with most fire damage observing the patterns made by the movement of heat, smoke, and flames (demarcation lines & V patterns).

Patterns should become heavier and/or darker and lower as the room of origin becomes closer.

7. The direction of fire travel must be explained by showing a continuity of the patterns produced by the movement of the by-products of fire.
8. The next step is to determine the point of origin within the room of origin.
9. Examine debris at the origin. It must be removed carefully, layer by layer, looking for evidence of the heat source and identification of the first ignited material.
10. The types of heat are mechanical, electrical, solar, chemical & direct flame. The following are summaries of useful reminders in determining heat sources.
11. The fire cause is the reason or event that brought the heat source a& first ignited item together. The fire cause is based on opinion, which is formulated on the evidence (information) gathered.
12. When determining cause, compare the information (evidence) gathered through questioning (firefighters, owner, occupant, & witnesses) with the information (evidence) gathered through examining (surrounding area, exterior, interior).
13. When determining fire cause, always consider the five most common causes of accidental fires (cooking, heating, electrical, careless smoking, and children playing with fire).

Critical observations:

1. Doors and windows - open /closed & locked/unlocked? _____
2. Smoke and flames on arrival? _____

Indicators related to combustion:

1. Multiple points of origin
   a. Trailers
   b. Flammable liquids at origin
2. Intense unnatural fire
   c. Unusual fuel load or configuration
3. Absence of all accidental causes

Other Indicators of arson:

a. Remote locations
b. Fires near appliances
c. Missing contents
d. Missing personal items
e. Entry blocked
f. Sabotage to structure

4. Evidence of other crimes
5. Indicators of forced entry

Reminders before finalizing cause determinations.

1. Floors must always be examined in the area of origin.
2. Determine how ventilation occurred and it's affect on the fire
3. Determine if flashover occurred and it's affect of any floor patterns.
4. Obtain insurance information.
5. Examine the underside of shelving, chairs, tables, etc. in the room of origin.
6. Examine the sides of floorboards if there are floor char patterns at the origin.
7. Determine if there was a delay in transmitting the alarm.
8. The presence & operational ability of any fire protection systems must be made.

9. Both involved and un-involved areas should be checked for abnormal placement of contents.

Interviewing: The minimum interviews are first responders, who reported the fire, who discovered the fire, the owner, occupants, and obvious witnesses or neighbors. Write on attach extra sheets or place information in the comments section of the incident report. Each interview should list proper name, DOB, address, & phone number or method of follow-up contact.

NOTES: